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ABSTRACT

The shift from viewing reading as primarily a perceptual process to viewing it as primarily a linguistic process, combined with the consideration of reading failure as not one but many disabilities, formed the basis for the assumption that there exists a duo-symbiosis between reading and speech and between speech and word-finding. The development of this assumption is traced through a model of word-retrieval which indicates areas of possible intersection between word-retrieval and reading. Ways of testing the basic assumption are suggested, and implications for research in reading and reading disability are discussed, including the suggestion that particular word-finding patterns may be able to predict specific reading problems. (Author/AM)

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THE WORD-RETRIEVAL PROCESS AND READING FAILURES

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The rather piquant combination of the two topics of this presentation must appear, at first blush, puzzling to some of you. The conjunction of the two areas emerged, in fact, as the circuitous result of trying to make sense of several puzzle pieces in the recent literature on children's reading failures. Two developments in the psychological research on reading form the conceptual backdrop for this pairing. The first is a shift from viewing reading as a predominantly perceptual process to a view of reading as a primarily linguistic process. Two researchers exemplifying this change are Liberman and her colleagues at Haskins Lab and Vellutino and his work on the "verbal-deficit hypothesis"; both focus on the role of language in reading acquisition, fluency, and dysfunction.

The second, concomitant development influencing this topic's conjunction is the shift in reading research about the nature of reading failure (typically called developmental dyslexia). Previously considered one large, albeit lumpy, disability, reading failures are now considered Janus-faced, Argus-eyed phenomena---multi-antecedent, multi-cause (Wiener & Cromer, 1967). Representing such a view are the syndrome breakdowns of dyslexia by Mattis,

Rapin, and French (1975) and Denckla (1977). This type of analysis attempts to find discrete, non-overlapping patterns or clusters of problems in reading dysfunctioning. Pertinent to this research, these analyses show that the two largest subsyndromes are clusters of language-related problems. In addition, the largest subsyndrome is characterized by some form of word-finding problem.

Into the context of these research shifts come the actual puzzle pieces about reading and word-retrieval, also called word-finding, lexical accessing, and less precisely, naming. As early as 1965, Geschwind suggested that a child's ability to name colors might be as good an indicator as any of the child's readiness to begin reading. Behind this hypothesis was the idea that like reading letter/symbols, naming colors represents giving a word or concept to an abstract, purely visual stimulus. Pursuing this suggestion, Denckla (1972) found that slow inaccurate color namers in kindergarten tended to have reading problems in the first grade. In the last five years Denckla and her colleague Rudel have conducted a series of investigations of naming, using a "rapid, automatized naming" measure. From their results Denckla and Rudel have concluded that "dyslexic children are subtly dysphasic" and have a mild anomia (1976). I was intrigued here not so much by idea of mild dysphasia in disabled readers, but by the implicit thought that an anomic disorder could disrupt or break down reading.

I began to find support for this hypothesis from many sides: neuropsychological and neurological literature on aphasia, reading research, and clinical work in speech and language problems. For example, Luria (1970) stated that reading and writing are special levels of speech activity influenced by any dysfunction in naming. In his study of word frequency and aphasia Howes(1964) asserted that the most characteristic feature of all aphasia is word-finding difficulty---either in accuracy or speed of response. The aphasia

researcher Goodglass found surprisingly high correlations between reading and naming ability scores in aphasic patients. Critchley (1970) reported the frequent pairing of anomia and alexia (severe reading failure caused by cerebral damage). The literature on both anomia and alexia appeared filled with pieces of evidence that needed connection. Reading researchers Jansky and de Hirsch have long found that tests of naming are the best predictors of reading achievement. Most recently Jansky (1976) remarked that a basic rhythm is essential to reading and that dysfluency caused by a child's retrieval problems could easily be the source of great reading difficulty. Perfetti and Hogaboam (1975) hold a similar view. This makes a good deal of sense if one looks at the degree of automaticity required in fluent reading, as described in LaBerge and Samuels' model of reading. It also makes us examine more closely the child who says after several mental trials "raindrella" for "umbrella" and reads "kitten" for "cat" (Cicci, 1976). The last piece in the puzzle is a remark by language researcher Bashir (1976) who stated that whatever is at the root of naming problems may also be at the root of reading failure.

Connecting all these pieces, it seemed to me, was an as yet unstated relationship between the reading and word-retrieval processes: a kind of duosymbiosis between reading and speech, on the one hand, and between speech and word-finding on the other: i.e., the word-finding process is near the heart of the speech/language process; reading is a complex but language-based skill; therefore, the word-finding process should play some part inside the reading process and could affect reading acquisition, fluency, and failure.

The implications of such a relationship are, at least to this author, very exciting. Perhaps the most far-reaching of these implications lies in the potential prediction power. For, if naming and reading share parts of the same system, and since naming is learned first, we might be able to predict specific reading failures from specific word-retrieval patterns

and errors. The rest of this presentation is a first step towards giving flesh, sinew, and skeleton to this idea. It is first and last a theory paper for the purpose of generating hypotheses. The actual research needed to support this idea will be given next year.

For the present, the emphasis will be on understanding the complexities of word-retrieval. (I ask as you listen, however, to actively connect in your own mind the research I'm presenting with your knowledge of children's reading.) I have broken my research down into three phases; in each phase a model was developed to incorporate the research in that period. The first step was something akin to an historical dig: I constructed a model of what word-retrieval might look like based on research on naming from 1885-1965. The following areas were emphasized: Cattell's work on latency, naming, and reading (1885); early neurological studies focusing on anomia beginning with Freund (1888)and Liepmann (1898) at the turn of the century; the German neurologists Goldstein (1948) and Lotmar (1933) and their work on anomic disorders ; and special emphasis on the series of studies on naming by Rochford and Williams (1962, 1963, 1965).

In the second step I elaborated upon the first model and constructed a second by incorporating recent findings on word frequency (particularly the work of Howes, Oldfield, and Wingfield), aphasia(with an emphais on research by Geschwind, Goodglass, and Luria), and relevant studies in verbal learning, child language, and developmental and cognitive psychology.
In the third and most preliminary step I reviewed current models of reading and attempted to plot possible intersections between reading and word-retrieval on a third model. In the remainder of this presentation I shall present an overview of the basic ideas represented in each phase's model; a more complete

explanation and rationale for each function or component is available in a longer paper by this author (Wolf-Ward, 1977).

Model 1

In the first model, roughly schematizing the research from 1885 to 1965, if a subject would be asked to supply a name to a picture stimulus, the following steps would be predicted to occur: Information comes in and is sorted at a perceptual level according to the nature of its content---e.g., color, word, object (Cattell, 1885). The perceptual system is divided into auditory and visual components because of the work of Liepmann and Freund on modality-specific anomias, where a person can not name in a particular sensory mode. They suggested that naming could be impaired by destruction in either visual or auditory systems. If the perceptual information that is presented is familiar enough, is presented at an appropriate rate (influenced by the presence of any contextual information) (Cattell, 1885), a perceptual threshold is crossed and something like a conceptual operation, or what Goldstein calls "categorizing," seems to occur.

The next operation in this first model appears to be something not unlike a phonological and semantic operation which directs the search to the right sound and/or meaning sphere in the lexicon. The theoretical basis for postulating this operation is the body of data collected by the German neurologist Lotmar on his anomic patients' verbal "derailments" when they couldn't find a word. These errors were divided by Lotmar into phonological and semantic categories.

That there appears to exist a component that functions like a "word-store" is implied in most of the research. The first formal mention of such an operation seems to be Mills and McConnell's paper in 1895 on the brain's "naming center". With a variety of names between then and the present, common description usually refers to this operation as the lexicon. Retrieval of words from the lexicon is influenced most by frequency and age of acquisition according to Rochford and Williams (1962, 1963, 1965). Finally, the word must

be articulated by the motor system as the last step in this first model's depiction of naming a word in response to a visual stimulus. This entire process, incidentally, takes place at approximately one-half second, and the average person has 75,000 ± 3,500 words from which to choose (Oldfield,1966).

Model 2

The second model shows an expanded version of the first and incorporates research up to the present time. The basic schema is the same but many variables have been added, particularly to the early perceptual operations. Immediately obvious is the emphasis on attention, memory, and the necessity to integrate information from bi-hemisperic sensory systems. Based heavily on the work of Goodglass, Barton, and Kaplan (1968), a hierarchical and differentiated perceptual system is depicted here. According to this model, each sense modality has its own threshold which must be crossed before a general perceptual threshold can be reached. Furthermore, there is pictured now a cumulative modality effect whereby the combined effect of different modalities will help meet the general threshold. Such an effect is given other support by North (1971) and Gardner's studies of operativity and naming (1973, 1974).

Whether the perceptual information is sufficient to meet the general threshold is shown here to be influenced by several factors: 1) the rate of the information's presentation (Kok, 1964; Luria, 1970); 2) rate of processing by each part of the system (Luria, 1973); 3) amount of stimulus clarity and redundancy (Luria, 1970; Bisiach, 1966); 4) the interaction of rate with sensory memory (suspending current controversies over the nature of memory here, sensory memory is typically believed to fade rapidly, requiring, therefore, a particular rate of presentation and processing; see Crowder, 1976). Finally, allthese factors seem to be developmentally related. Thus a young child would seem to have a somewhat shorter memory duration (Belmont & Butterfield, 1969; Flavell, 1970), would require more semsory redundancy, and would probably have

a generally slower rate of processing. In addition, the work of Vygotsky, Levina (as discussed by Luria, 1970), Newcombe, Oldfield, Ratcliff, and Wingfield (1971) suggests that the auditory system plays a much more crucial role in word-retrieval for the young child, while Goodglass, Barton, and Kaplan (1968) suggest that for the adult, the visual system may be more important.

After information crosses the general perceptual threshold in this second model, a preliminary abstraction categorizing process occurs. Goodglass refers to this operation as the "concept"---"The net sum and pattern of associations provided by modalities" (Goodglass, Barton, & Kaplan, 1968). A case study on word-category aphasia by Yamadori and Albert (1973) supports such an operation: they suggest along with Kinsbourne and Warrington (1964) that categories such as colors, room or body parts may have an independent existence in the process of word storage and retrieval.

How information is categorized is shown on this model to be influenced by context (Luria & Vinogradova, 1959), syntactic information (Goodglass, 1973), previous learning (Miller & Johnson-Laird, 1976), nature of the task (Barton, Maruszewski,& Urrea, 1969) and development (Luria & Vinogradova, 1959). Crucial to categorization are the phonological and semantic operations. Although they are shown on the model as separate entities superimposed over the lexicon, like Miller and Johnson-Laird, we can't really know where the lexicon begins and the phonological/semantic operations leave off. Support for these operations can be found in Lotmar's "derailments" (1933), the studies of paraphasic errors (Rinnert & Whitaker, 1973), the TOT ("tip of the tongue") research by Brown and McNeill (1966), Barton (1971), and Goodglass, Kaplan, Weintraub, and Ackerman (1976), and from studies of the "orienting reflex" by Luria and Vinogradova (1959). The TOT studies that attempt to tap the generic recall of aphasics show that "the tacit knowledge of a target word" may be able

to differentiate particular varieties of aphasia. Tacit knowledge refers here to such things as knowledge of the first sound of the target word, the number of syllables, the general semantic sphere, etc. (Note: a series of provocative research questions emerges from this line of investigation: for example, could TOT studies be designed to tap the development of language in young children? in bilingual children - their tacit knowledge of the second language ? Using similar, but more refined TOT measures, could we perhaps differentiate "dyslexic" readers from average readers? Could we differentiate specific subgroups of disabled readers parallel to the syndromes described by Mattis et al. (1975) and Denckla (1977)? Finally, would there appear similarities between patterns of tacit knowledge of words between types of aphasics and the subsyndromes for dyslexia? A group of studies based on several of these questions is being initiated by this author.)

But to return to the body of this presentation, there also appears to be a developmental dimension in categorization in at least two ways. Studies by Luria and Vinogradova (1959) suggest that younger children in accessing words have at first very disorganized strategies and then develop the use of phonological cues; older children seem to make more use of semantic cues in retrieval. These researchers also found that the use of particular cues was influenced by context, fatigue, and degree of learning. (An interesting parallel can be drawn here with Liberman and her associates' work on phonemic recoding in the reading of poor and average readers: the poor readers unlike their peers do not seem to rely on any organized phonemic recoding strategy in their word attack.)

A second developmental dimension affecting not so much categorization but lexical access and retrieval seems to be the age at which a word is acquired. Rochford and Williams (1962) found in their study of adult aphasics and average children that the words least vulnerable to loss were the words first acquired.

Carroll and White (1973) extended this notion and suggested a kind of tree trunk lexical arrangement to explain how words first acquired are last lost and first accessed---here the words are most protected but also quickest found. An alternative hypothesis is given by Luria (1973) who suggests that these most commonly used words have built over time the strongest neuronal circuits.

Closely related to the age of acquisiton variable is the influence of word frequency. Lotmar was the first to study the effects of familiarity on the ease or difficulty in actual retrieval. Studies by Howes (1964), Rochford and Williams (1965), and an indepth series of studies on this topic by Oldfield and Wingfield (1964, 1965) suggest that the higher frequency a word has, the quicker and easier it will be accessed and the less likely it will belost.

The last of the lexical operations ---a retrieval validation---is one for which there is little evidence outside of intuitive appeal, except for part of James' famous, cellifluous quote on the TOT phenomenon: "If wrong names are proposed to us, this singularly definite gap acts immediately so as to negate them..." (1890). Before the search is finished, some kind of confirmation system seems to be operating and would most probably be influenced by memory processing.

The final component or operation in the entire retrieval process is the most visible or audible: the motor system, which translates the retrieved information into an organized set of articulatory commands.

Model 3 The final and most hypothetical addition to the model plots the possible intersection of the reading process. The perceptual, lexical, and motor operations remain the same, but I hypothesize that at the concept/categorization level a direct, perhaps "automatic",route develops in reading that goes through the phonological operation but skips part of semantic categorization. This tentative hypothesis is based on the work of Fraisse (1968, 1969), Lignon (1932), and Seymour (1973), each of whom studied the reasons why naming takes longer than reading in the processing of the same stimulus. In addition , theories of automaticity in reading (La Berge &

Samuels, 1974) and the clinical observations of Jansky and de Hirsch and Masland (1976) were used to construct this plotting of reading. Fraisse (1968, 1969) shows that if a subject is given a circle, square, or triangle as stimuli and the letters "a", "o", "e", it will take longer to name "o" as a circle, than as "o" the letter. Fraisse concluded from this that in naming "several responses, at least a specific and a categorical one" are required, while in reading only the specific is required and the categorical shortcutted (1969). Similarly, Seymour (1973) holds that reading and naming share parts of the same system but diverge after the perceptual operation where he posits a pictorial/graphemic analyzer (not unlike Cattell, 1885) to account for the found differences in latencies.

This completes the description of the model of word-retrieval and reading to date. As stated, the overview is necessarily simplified and buttressed here by only part of the research supporting it; furthermore, the model will change as my research base grows. Regardless of how the model will eventually evolve, however, I believe there is a strong case to be made here for reading and naming as co-users of the same system. I propose, therefore the design of a refined instrument of word-retrieval that tests naming under a variety of conditions based on the final model's operations. The following conditions should be tested: 1) visual naming of picture of objects with varying degrees of redundancy, clarity, word frequency; 2) similar conditions should be tested for auditory and tactile modalities; 3) modality preferences or hierarchies should be tested for different ages by comparing latencies on words with visual, tactile, and auditory dimensions; 4) a cumulative modality effect might be tested by comparing latencies of words with single modality associations (e.g., color words) and words with multiple associations; 5) rate of presentation effects could tested in general and on particular categories of words, words with differing frequencies and length; 6) phonological

and semantic organization might be tested through the use of different prompts when the subject failed to name a target word; 7) a variety of kinds of testing formats like cloze and naming to description or definition should be used to test effects of context and syntactic skills.

It is my best guess that such a test will yield patterns of errors that could give us a great deal of information about the development of language in young children, in bilingual children and adults, and in children with reading disorders. Secondly, it is my speculative, but not so farfetched hunch that the patterns of word-finding errors in disabled readers will correspond to specific syndromes of reading failures. (See Attached appendix for a hypothetical match between syndrome patterns of disabled readers and possible word-finding error patterns.) Finally, and most tentatively, I believe that such a test might be able to predict from a young child's word-finding and tacit knowledge of the language, the kinds of problems he or she might have in later reading.

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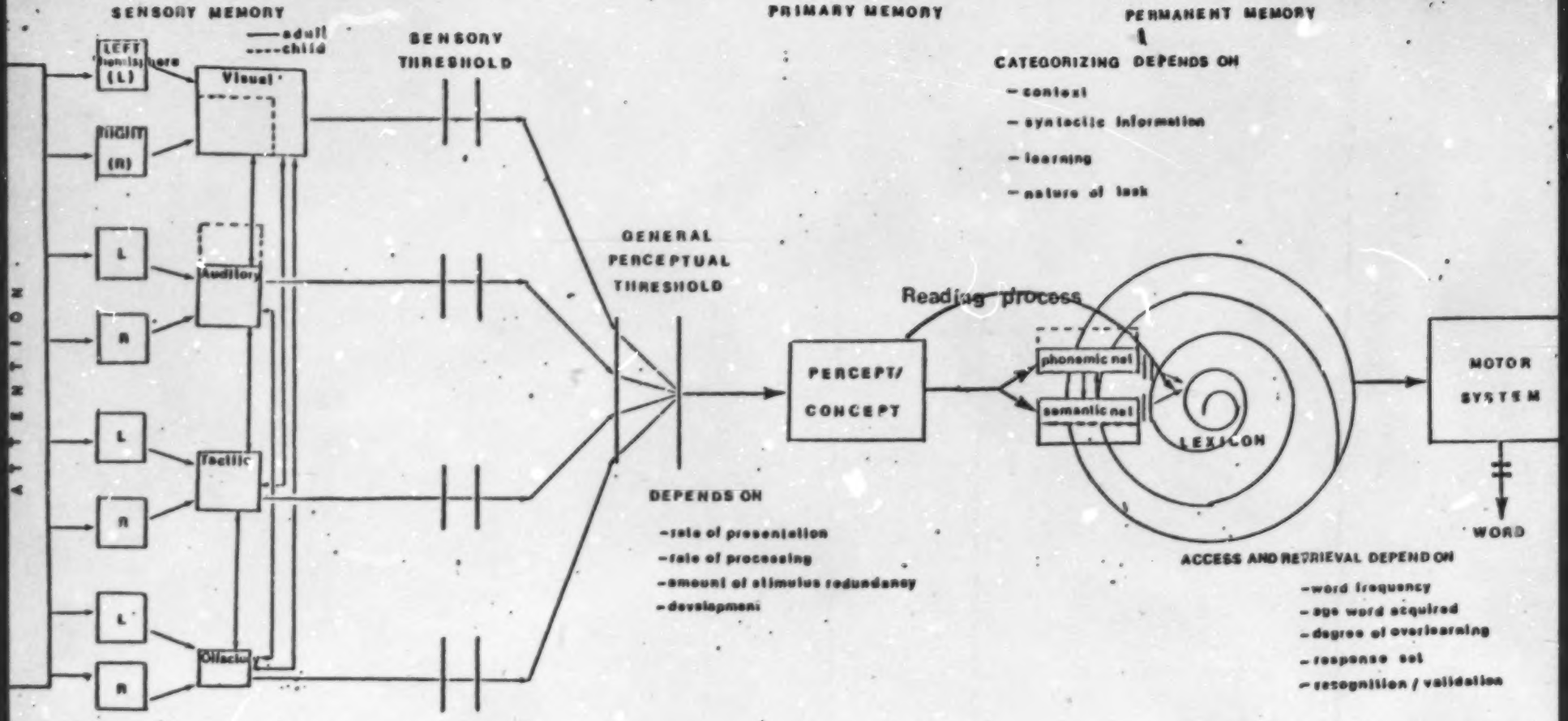

Hypothesized Model of Word-Retrieval and Reading; Phase 3

Wolf-Ward: Word-retrieval process and reading failures.

Boston University Language Conference, October 1, 1977

APPENDIX

Hypothetical Match of Syndrome and Word-finding Pattern

Mattis, French & Rapin Syndrome and Description	Denckla Syndromes	Word-finding pattern prediction (based on tasks in Appendix F)
1. Visuo-spatial perceptual disorder: •high verbal score •low Raven's Coloured Progressive Matrices •low Benton Test of Visual Retention	1. Visuo-spatial (defined as in Mattis but found that they also were anomic: this corresponds to model's prediction based on Bisiach)	1. Color-naming problems Lower on visual clarity test Error analysis would show more unrelated and perceptual errors than semantic or phonological.
2. Articulatory and graphomotor dysco-ordination •sound blending poor •low graphomotor skills •acousto-sensory and receptive language normal	2. Articulatory-graphomotor (defined in Mattis)	2. Phonological errors dominate Possibly poor tactile naming. Perceptual clarity tests OK Long latencies
3. Language disorder (no subcategories) •anomic •comprehension disorder •imitative speech disorder •speech-sound discrimination disorder	3. Language disorder a. mixed (i.e. poor naming, comprehension, repetition, and phonemic memory/sequencing) b. anomic & repetition poor (poor on Oldfield-Wingfield, repetition, RAN tests; normal on comprehension c. anomic pure (like above but repetition OK) d. dysphonemic sequencing (poor repetition & phonemic substitutions and missequencing; comprehension & naming OK)	3. a. Poor accuracy and long latencies Poor repetition scores Poor auditory-clarity test Semantic and phonological errors b. Poor accuracy, latency, repetition scores Semantic errors c. Poor accuracy, latency Semantic errors d. Poor latency, repetition Phonological errors Auditory-clarity test down.
	4. Verbal memorization disorder (poor sentence repetition & paired associate learning)	4. Poor repetition
	5. Right hemisphere with mixed language disorder.	5. Errors more perceptual or unrelated variety.